is high; the length of the best preserved one 18mm, the breadth 3–4mm. There are no traces of a division into endopodites and exopodites; but we should regard the parts preserved as the homologues of the exopodites of Nebalia; there are no traces of setæ on the edges. The general appearance of the appendage is much as in Pl. xxxvii, Fig. 6, of our monograph of North American Phyllopod Crustacea. Length of the carapace 46mm; height at the highest part, 26; at the anterior end 12–13mm.

From the foregoing description it seems reasonable to suppose that in the fossil forms, Ceratiocaris and allied forms at least, the thoracic feet were, in shape and structure, homologous with those of the modern Nebalia.

Beyond the feet, at the larger or posterior end of the carapace is the impression of what may have been the basal joint of one of the basal abdominal feet, which joint in Nebalia is as long as the lamellate thoracic appendages; but this, of course, is quite problematical.

It is not a little strange that no undoubted traces of the antennæ or basal abdominal limbs of any extinct Phyllocaridan have as yet been brought to light; but the discovery of these large, broad, thin, lobular appendages which most probably belonged to the thorax, makes it all the more likely that the extinct Phyllocarida had antennæ, and basal abdominal limbs similar to those of the existing Nebalia.

Explanation of the Plate.

Fig. 1. Cast of carapace of *Cryptozoe problematicus* Pack., natural size.

Fig. 2. Reverse of the same, showing the impressions of the lamellate feet originally attached to the thorax.

The Use of Oil in Storms at Sea. By Lieut. A. B. Wyckoff, U. S. N.

(*Read before the American Philosophical Society, April 2, 1886.*)

My attention was drawn to this subject in 1884, soon after I took charge of the Branch Hydrographic Office in Philadelphia. Several Masters of vessels described their methods of using it, and the striking results of their practical experiments. I became convinced of its great utility; and in November, 1884, reported the matter in a letter to the Hydrographic Office. Soon afterwards, orders were given the branch offices, to collect all the information they could obtain regarding its use; and in January, 1885, the data, thus collected, was published upon the monthly North Atlantic Pilot Chart. This has been continued ever since, and the Hydrographer, Commander J. R. Bartlett, has done everything in his power to interest mariners in the subject. In consequence, where one vessel formerly used it, there are probably now fifty prepared for such an emergency.

In view of the unvarying successful result, the time must soon come, when no vessel will leave port without some cheap fish or vegetable oil, for this purpose. Insurance companies, owners and masters of vessels, are all too greatly interested, to have this precaution longer neglected.

The use of oil in calming troubled waters, was evidently well known to the ancients, as Aristotle, Plutarch and Pliny refer to it in their writings. The divers in the Mediterranean still use it in the manner described by Pliny—taking oil in their mouths, and ejecting a little at a time, to quiet the surface and permit the rays of light to reach them. Fishermen, who depend upon the spear to capture their prey, pour oil on the water to calm it, and enable them to clearly see the fish. The hardy fishermen of the north of Scotland and along the shores of Norway, have known this use of oil for centuries. When crossing a dangerous bar or tide-rip, or when landing through surf, they press the livers of the fish until the oil exudes, and then throw them in advance of their boats. The Lisbon fishermen carry oil with them, and use it in crossing the bar of the Tagus, in rough weather. Whalers have resorted to oil and blubber, in severe storms, for the last two hundred years. Very recently, an old whaler informed me, that it was their custom to hang large pieces of blubber over each quarter of their vessel, when running before a heavy sea, and it entirely prevented the water coming on board.

The members of this Society should take special interest in this subject, because its founder made many experiments, and left his views on record regarding the great utility of oil for this purpose. On a stormy day, he calmed the surface of a pond covering a half acre, by pouring a single teaspoonful of oil upon its windward side. He afterwards made other laborious tests upon the waves of the sea, and gave a scientific explanation of the manner in which the oil acted. This explanation is still believed to be substantially correct.

Molecules of water move with freedom, and the friction of air in motion upon the surface of a body of water, produces undulations. These increase in size, proportionately to the depth of water, the distance they can proceed to leeward, the strength of the wind and the time it is acting. There is a limit, of course, to this increase in height; none probably ever exceeding forty feet.

The precursor of a cyclone in the North Atlantic, is often, what is known to seamen, as a heavy swell. It may be perfectly calm when this reaches a vessel. It is simply a long, high undulation; started by the storm, and traversing the ocean in advance of it. Off the coast of California, I have experienced the tremendous swells, made by a westerly wind across the immense stretch of the North Pacific. These undulations were as high as any I have ever seen, and yet, on calm days, I have often ridden them in an ordinary whale boat. These swells correspond to oiled waves. The boat or vessel slides up their front slope, and down the rear. Let a sudden gale spring up, like the "Northers" in the Gulf of Mexico, and the harmless swells becomes raging seas. How is this change effected?

The friction of the wind, upon the exposed slope of the swell, produces little irregularities of the surface. These wavelets are driven up the slope to the summit of the undulation. At the same time, the forward slope is more and more protected from the wind, and, because of its inertia, becomes steeper and steeper. Any one who ever saw a sand dune within the limits of the trade winds, has seen the storm wave in permanent form —a long windward slope and abrupt leeward face. The constantly sharpening crest of the storm wave, is finally thrown forward and downward with a force proportionate to its weight and speed. When this storm wave encounters a ship, the vessel cannot rise up the abrupt front. Instead, she checks the progress of the base of the wave, and the crest is thrown forward with tremendous violence, filling her deck and sweeping away men, boats and everything movable. The storm wave is, perhaps, no higher than the heavy swell, and only differs from it in shape. Oil changes the storm wave into the heavy swell. How is this done? The scientific explanations given with great minuteness, that I have seen, would only be confusing to the ordinary mariner. My opinion is : that the oil with its less specific gravity floats on the surface, and spreads rapidly, forming a film, like an extremely thin rubber blanket, over the water. Because of the viscosity of the oil, and its lubricant nature, the friction of the wind is not sufficient to tear this film, and send individual particles rolling up to the summit. At the same time, the molecules of water beneath are protected ; and, although the force of the wind may increase the speed of the undulation as a body, it will be as a heavy swell, and no longer in the shape of a storm wave. This effect can always be obtained at sea, if a suitable oil is used. It has been supposed, that the oil exerts some chemical action in dissolving the foam, as is witnessed, when it stops the frothing of pulp in a paper mill. It is more probable, however, as Dr. Franklin says, that the effect is purely mechanical.

I have examined one hundred and fifteen reports of the use of oil in storms at sea, published by the Hydrographic Office, and find all the trials were very successful, except four. In these, refined petroleum was used. In one instance, sperm oil was said to have thickened so that it did not spread freely ; but in four others, it acted very well. Fish oil was used 9 times, crude petroleum 3, pine oil 3, linseed 22, lard 5, neat's-foot 1, colza 2, and varnish 3 times. In 58 trials, the kind of oil used is not specified. It is apparent, that the heavier oils are the most efficacious. The result in every instance, where used by a novice, is of extreme astonishment at the wonderful effect. One trial seems convincing, and soon it is hoped, the whole profession of merchant officers will be converts, and always go prepared.

In using oil for this purpose, it is evident that it must be spread well to windward, in order to be efficacious. In consequence, a steamer plunging into a head sea, or a sailing vessel on a wind, can derive no benefit. But any vessel driving before a gale, or lying to and making a dead drift to leeward, gets the full protection of its use. As all vessels, except per-

haps the rapid passenger steamers of the Atlantic, assume one of these two positions in a storm, the oil is of very general application. Even the fast passenger steamers, in crossing to the eastward before the winter gales, or when, for any reason, their machinery is stopped, will find it invaluable in saving their boats and upper works. Many vessels have found it of great utility, in passing the dreaded trough of the sea, either in heaving to or getting before the wind.

The ordinary methods adopted for distributing the oil are: to pour it down the pipes forward, or place oil alone, or oil and oakum, in canvas bags with holes punched in them, or in bags made of coarse material, as gunny or corn sacks. These are hung over the ship's side wherever required. In my opinion, the bags should always be placed over the bows; as in running, there is time for the oil to spread, and when lying to, it is needed as far forward as possible. From the reports received, I should judge that one gallon of oil, when properly distributed, should last a vessel at least four hours.

In lowering a boat in a sea-way, oil is of great advantage. If to rescue the crew of a disabled vessel, the rescuer should take a position to windward, and distribute a quantity of oil. After the boats have been started, the rescuing vessel should drop to leeward to pick them up. The boats should carry oil to use in running before the sea.

A bottle of oil, with a quill in the cork, should always be kept attached to every life buoy. When a man falls overboard and reaches the life buoy, the oil will prevent the waves breaking over him, and enable the rescuing boat to find him, by the "slick" on the water. There should be an oil tank in every ship's boat, in the event of it becoming necessary to abandon the vessel. Riding to a drogue, made of the masts or oars, a small expenditure of oil will enable a boat to live through a severe storm.

At the entrance of a harbor, or river with a deep bar, oil can be used to great advantage, as has been proven by the experiments in England. When, however, the waves strike a beach, the problem becomes very different. The base of the wave is then retarded by the shoaling depth and the undertow from its predecessor, and, of necessity, the crest is thrown violently forward. Oil cannot prevent this; but it will certainly have considerable effect upon the outer line of breakers, and enable a boat to approach so much nearer the beach, as to greatly increase the chances of a favorable issue. However, many instances are given of the successful landing of boats, through surf and breakers, that would have overwhelmed them without the use of oil.

I append some illustrations of the practical use of oil, in some of the emergencies to which I have referred.

In 1881, a Mr. Fondacaro arrived at Naples from Montevideo, in a three-ton boat built by himself. When caught in a gale, a bag was thrown over as a drag; and two oil bags were put over, one forward and the other aft. The oil circled around the boat, and prevented the seas breaking over her.

One gallon of oil lasted about twenty-four hours. Mr. Fondacaro says, "the oil does not diminish the size of the waves, but renders them comparatively harmless by preventing them from breaking."

The chief officer of the S. S. *Diamond*, wrecked off the Island of Anholt, describes their escape from the wreck. He provided each boat with a five-gallon can of oil, and stationed a man to pour it gradually over the stern. Immediately the sea, in the wake of the boats, became perfectly smooth, and they passed right through the boiling surf, and reached the land in safety, without shipping a sea. None of the men in the boats believed, when they left the ship, that all would reach the shore alive; and the people on land watched their approach in wonder, deeming it impossible for even the life-boat to live in such awful breakers. (The chief officer evidently means, that the sea ceased to break in the wake of the boats; not that it became perfectly level.)

Capt. E. E. Thomas, of the S. S. *Chillingham*, writes, that during a voyage from Philadelphia to Queenstown in March, 1883, he encountered a heavy gale from S.W. "For forty-eight hours we ran before the gale, and during the whole of the time we shipped very heavy seas, and the decks were continually full of water fore and aft. We then had two oil bags made, filled them, and made one fast to the ring of each anchor over the bows. Within a few moments we saw the effects of it on the seas. In the wake of the ship they did not break, whereas, outside of our wake the waves were breaking in all directions. Up to then, we had run before the gale for forty-eight hours without heaving the log, none of the crew daring to go aft for fear of being washed overboard. After using the oil we did not ship any heavy seas whatever, and ever since we always use oil when running before a heavy sea. I would also recommend it to be used in ships that are lying to in heavy seas. The bags were slung about two feet below the anchors, so that when the vessel pitched they were, at times, just awash. About one quart of colza oil was put in each bag every four hours."

Capt. Jones, of the British S. S. *Chicago*, while rescuing the crew of the brigantine *Fedora*, used oil with the best results. It was blowing a heavy gale with very high seas. The *Chicago* ran to windward of the *Fedora*, and, during a lull, oil having been poured on the water, the port life-boat was successfully launched and started. A can of oil was taken in the boat, and by using this the seas were kept down in the immediate vicinity, though they broke in masses of foam a short distance away. As the boat approached the *Fedora*, the crew of that vessel poured oil on the water, which so calmed the sea that the boat got alongside and rescued the shipwrecked crew without sustaining any injury. About half a gallon of paint oil was used by the boat during her trip.

The S. S. *Menzaleh*, in March, 1885, from Italy to Philadelphia, encountered a severe S. W. gale. While running before the sea, the vessel was pooped and the main hatches were stove in. It was determined to heave to, and men were stationed to drip oil down the forward shutes. The

vessel came around without shipping any water, and kept perfectly dry while lying to.

Captain J. E. Lewis, master of schooner *Lawrence Haines*, reports that he used oil when hove to in a terrible N. N. E. gale off Hatteras, on December 26th and 27th; force of wind from fifty to sixty miles per hour. He put over three bags containing oakum and oil; one forward, one aft, and one amidships, and hanging so as to dip as the vessel rolled. Oil used, mixture of linseed, tar and kerosene oil. The bags were used thirty hours, and three gallons of the mixture were expended. He claims that his vessel was saved by the use of oil.

Captain E. L. Arey, of the schooner *Jennie A. Cheney*, writes: "I used oil with very satisfactory results during the late severe hurricane of the 25th of August, in latitude 31° N., longitude 79° W. The wind having carried away the mainsail, I bent a storm trysail, and continued under that sail until it also blew away. During the time, the vessel was shipping large quantities of water, the sea being very irregular, nearly every one breaking. After the sails were blown away, finding it necessary to do something to save the ship and crew, I took a small canvas bag and turned about five gallons of linseed oil into it, and hung it over the starboard quarter. The wash of the sea caused a little of the oil to leak out, and smoothed the surface, so that for ten hours no water broke aboard. I consider that the oil used, during the last and heaviest part of the hurricane, saved vessel and crew."

An Obituary Notice of the Late George Whitney. By William Sellers.

(*Read before the American Philosophical Society, February 19, 1886.*)

The subject of this memoir was born in Brownville, New York State, October 17th, 1819. He was educated at the Albany Academy, Albany, N. Y., where he distinguished himself by his quickness of perception and aptitude for learning, which enabled him to carry off the honors of his class in successive competitive examinations and to obtain a large share of the prizes given each term.

At an early age George Whitney developed a decided preference for studies in natural philosophy, drawing and mechanics. In 1832 his father, Mr. Asa Whitney, was appointed Superintendent of the Mohawk and Hudson River Railroad, one of the earliest steam roads in this country, and his son George availed himself, on all holiday occasions, of the opportunity thus presented of acquiring familiarity with the mechanism of the engines and the practical operation of the road.

As a draughtsman, George Whitney was equaled by few, and his beautiful drawings of some of the first English locomotives sent to America